

Stress Analysis of GRP/GRE/FRP piping system using CAESAR II

GRP products being proprietary the choice of component sizes, fittings and material types are limited depending on the supplier. Potential GRP vendors need to be identified early in design stage to determine possible limitations of component availability. The mechanical properties and design parameters varies from vendor to vendor. So it is utmost important that before you proceed for stress analysis of such systems you must finalize the GRP/FRP/GRE vendor. Several parameters (Fig. 1) for stress analysis have to be taken from vendor.

Stress analysis of GRP piping system is governed by ISO 14692 part 3. The GRP material being orthotropic the stress values in axial as well as hoop direction need to be considered during analysis. The following article will provide a guideline for stress analysis of GRP piping system in a very simple format.

Before you open the input spreadsheet of CAESAR II communicate with the vendor through mail and collect the following parameters as listed in Fig.1.

Parameters Required for GRP/GRE Piping Stress Analysis	
Pipe Diameter	Parameter Values
Pipe Outside Diameter, OD	165.7 mm
Pipe Structural Wall Thickness, tr	12.5 mm
Elbow Data	
Elbow structural wall thickness, ta	38.1 mm
GRE Mechanical Properties	
Elasticity modulus, Ea	17030 MPa
Elasticity modulus, Eh	28131 MPa
Shear modulus, G	11000 MPa
Poisson ratio, $\nu_{hoop/axial}$	0.59
Poisson ratio, $\nu_{axial/hoop}$	0.36
$Ea/Eh \cdot \nu_{hoop/axial}$	0.36
Thermal expansion coefficient, α	15.7×10^{-6} mm/mm/C
Long Term Axial strength at 2:1 stress ratio, $\sigma_{al}(2:1)$	54.9 MPa
Long Term Axial strength at 0:1 stress ratio, $\sigma_{al}(0:1)$	39.3 MPa
Long Term Hoop strength at 2:1 stress ratio, $\sigma_{hi}(2:1)$	109.8 MPa
Qualified Stress for Joints, σ_{qs}	109.8 MPa
Bi - Axial stress ratio for Joints [r]	1
Qualified Stress for Bends, σ_{qs}	109.8 MPa
Bi - Axial stress ratio for Bends [r]	1
Qualified Stress for Tees, σ_{qs}	109.8 MPa
Hoop modulus to the Axial Modulus Ratio, Eh/Ea	1.652
Thermal factor, K	0.85
Design Factors for GRE System	
System Design Factor, f2	0.67 (SUS), 0.83 (OPE), 0.85 (HYD)
System Design Factor, f3	1 (for U/G Pipe)
Partial Factor for Temperature, A1	1 (for Design temperature 75 deg. C)
Partial Factor for Chemical resistance, A2	1
Partial Factor for cyclic service, A3	1 (Static Design)

Fig.1: Parameters required for stress analysis of GRP piping

Grp Piping Pipe Stress Analysis Manual

S.I. Krishnamachari, L.J. Broutman



Grp Piping Pipe Stress Analysis Manual:

Analysis for Design of Fiber Reinforced Plastic Vessels Suong V. Hoa, 2017-10-19 First published in 1991 CRC Press is an imprint of Taylor Francis **Piping Calculations Manual** Shashi Menon, 2004-12-31 This on the job resource is packed with all the formulas calculations and practical tips necessary to smoothly move gas or liquids through pipes assess the feasibility of improving existing pipeline performance or design new systems Contents Water Systems Piping Fire Protection Piping Systems Steam Systems Piping Building Services Piping Oil Systems Piping Gas Systems Piping Process Systems Piping Cryogenic Systems Piping Refrigeration Systems Piping Hazardous Piping Systems Slurry and Sludge Systems Piping Wastewater and Stormwater Piping Plumbing and Piping Systems Ash Handling Piping Systems Compressed Air Piping Systems Compressed Gases and Vacuum Piping Systems Fuel Gas Distribution Piping Systems *Pipeline Risk Management Manual* W. Kent Muhlbauer, 2004-01-24 Here s the ideal tool if you re looking for a flexible straightforward analysis system for your everyday design and operations decisions This new third edition includes sections on stations geographical information systems absolute versus relative risks and the latest regulatory developments From design to day to day operations and maintenance this unique volume covers every facet of pipeline risk management arguably the most important definitely the most hotly debated aspect of pipelining today Now expanded and updated this widely accepted standard reference guides you in managing the risks involved in pipeline operations You ll also find ways to create a resource allocation model by linking risk with cost and customize the risk assessment technique to your specific requirements The clear step by step instructions and more than 50 examples make it easy This edition has been expanded to include offshore pipelines and distribution system pipelines as well as cross country liquid and gas transmission pipelines The only comprehensive manual for pipeline risk management Updated material on stations geographical information systems absolute versus relative risks and the latest regulatory developments Set the standards for global pipeline risk management

Applied Stress Analysis of Plastics S.I. Krishnamachari, L.J. Broutman, 2013-11-27 This book is a product of the understanding I developed of stress analysis applied to plastics while at work at L J Broutman and Associates UBA and as a lecturer in the seminars on this topic co sponsored by UBA and Society of Plastics Engineers I believe that by its extent and level of treatment this book would serve as an easy to read desktop reference for professionals as well as a text book at the junior or senior level in undergraduate programs The main theme of this book is what to do with computed stress To approach the theme effectively I have taken the stress category approach to stress analysis Such an approach is being successfully used in the nuclear power field In plastics this approach helps in the prediction of long term behavior of structures To maintain interest I have limited derivations and proofs to a minimum and provided them if at all as flow charts In this way I believe that one can see better the connection between the variables assumptions and mathematics

Updated Test and Design Methods for Thermoplastic Drainage Pipe Timothy J. McGrath, Ian D. Moore, Yick Grace

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Table of Contents Grp Piping Pipe Stress Analysis Manual

1. Understanding the eBook Grp Piping Pipe Stress Analysis Manual
 - The Rise of Digital Reading Grp Piping Pipe Stress Analysis Manual
 - Advantages of eBooks Over Traditional Books
2. Identifying Grp Piping Pipe Stress Analysis Manual
 - Exploring Different Genres
 - Considering Fiction vs. Non-Fiction
 - Determining Your Reading Goals
3. Choosing the Right eBook Platform
 - Popular eBook Platforms
 - Features to Look for in an Grp Piping Pipe Stress Analysis Manual
 - User-Friendly Interface
4. Exploring eBook Recommendations from Grp Piping Pipe Stress Analysis Manual

- Personalized Recommendations
- Grp Piping Pipe Stress Analysis Manual User Reviews and Ratings
- Grp Piping Pipe Stress Analysis Manual and Bestseller Lists
- 5. Accessing Grp Piping Pipe Stress Analysis Manual Free and Paid eBooks
 - Grp Piping Pipe Stress Analysis Manual Public Domain eBooks
 - Grp Piping Pipe Stress Analysis Manual eBook Subscription Services
 - Grp Piping Pipe Stress Analysis Manual Budget-Friendly Options
- 6. Navigating Grp Piping Pipe Stress Analysis Manual eBook Formats
 - ePub, PDF, MOBI, and More
 - Grp Piping Pipe Stress Analysis Manual Compatibility with Devices
 - Grp Piping Pipe Stress Analysis Manual Enhanced eBook Features
- 7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of Grp Piping Pipe Stress Analysis Manual
 - Highlighting and Note-Taking Grp Piping Pipe Stress Analysis Manual
 - Interactive Elements Grp Piping Pipe Stress Analysis Manual
- 8. Staying Engaged with Grp Piping Pipe Stress Analysis Manual
 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers Grp Piping Pipe Stress Analysis Manual
- 9. Balancing eBooks and Physical Books Grp Piping Pipe Stress Analysis Manual
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection Grp Piping Pipe Stress Analysis Manual
- 10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
- 11. Cultivating a Reading Routine Grp Piping Pipe Stress Analysis Manual
 - Setting Reading Goals Grp Piping Pipe Stress Analysis Manual
 - Carving Out Dedicated Reading Time
- 12. Sourcing Reliable Information of Grp Piping Pipe Stress Analysis Manual

- Fact-Checking eBook Content of Grp Piping Pipe Stress Analysis Manual
 - Distinguishing Credible Sources
13. Promoting Lifelong Learning
- Utilizing eBooks for Skill Development
 - Exploring Educational eBooks
14. Embracing eBook Trends
- Integration of Multimedia Elements
 - Interactive and Gamified eBooks

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